

MASSACHUSETTS FORESTRY CONSERVATION MANAGEMENT PRACTICES FOR FOUR-TOED SALAMANDERS

Draft (August 2007)



Prepared by

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This draft publication was produced by the Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife. Development of the draft conservation management practices (CMPs) provided herein was based on an interdisciplinary approach coordinated by the CMP Working Group. These draft CMPs will be subject to formal review during a public meeting and comment period (date TBD).

CMPs are meant to serve as guidelines for landowners and consulting foresters to aid in development of M.G.L. Chapter 132 Forest Cutting Plans that are compliant with provisions of the Massachusetts Endangered Species Act (MESA) (M.G.L. 131A) and its implementing regulations (321 CMR 10.00). In some cases, actual practices required for compliance with MESA may differ from published CMPs. Adherence to CMPs during forestry projects shall not necessarily constitute compliance with other state laws, or with local and federal laws.

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SUMMARY

The Four-toed Salamander is in the lungless salamander family (Plethodontidae) and is the smallest salamander found in Massachusetts. It breeds in wetlands such as swamps, bogs and marshes that have hummocks of sphagnum moss. Although these aquatic habitats are essential for reproduction, it is the surrounding terrestrial forested habitat where the juvenile and adult salamanders spend the majority of their time. Breeding migration of nesting females to and from aquatic habitat occurs in the early spring while courtship and mating occurs in the late summer and fall.

The primary concern about forestry practices within Four-toed Salamander habitat is habitat alteration around wetland breeding sites, and the subsequent mortality and decreased abundance of salamanders. Direct mortality of adults from mechanized equipment and soil compaction during harvesting operations is also a concern. To avoid habitat alteration that would render forested habitat inhospitable for Four-toed Salamander, a 50-foot no-cut buffer is required to be left around specified wetland breeding sites. Additionally, >75% canopy cover must be retained within 70% of the area that is within 250 feet from the breeding site. Access and operation of mechanized equipment within 250 feet of breeding sites must occur between November 15th and March 15th of any given year. No vehicles are allowed in, or within 50' of Four-toed Salamander breeding wetlands.

The Role of Forestry in the Conservation of Four-toed Salamanders

Maintaining forested land is vital to conserving viable populations of Four-toed salamanders. In addition, timber harvesting is often essential for private forestlands to remain economically viable, and if public and private forestlands are to supply renewable wood products to sustain local economies. However, forest managers need to recognize that harvesting can potentially result in a significant decrease in local salamander abundance, and should look to conserve Four-toed salamanders and other rare species proactively, in order to maintain the integrity of forest ecosystems.

**CONDENSED VERSION OF THE
FORESTRY CONSERVATION MANAGEMENT PRACTICES
FOR FOUR-TOED SALAMANDERS**

For the full version of the forestry conservation management practices including the management objectives and the rationale supporting them, see page 13.

Species Identification and Biology – The Four-toed Salamander is the smallest salamander in Massachusetts and can be recognized by having 4 toes on the hind limbs instead of the usual 5 and a constriction at the base of the tail. These salamanders lay eggs in sphagnum moss on hummocks that are surrounded by water. Females guard the eggs until the larvae hatch and drop into the water.

Forestry Practices - These management practices are based on the recognition that Four-toed Salamander conservation requires maintenance nesting site microhabitat and shaded, cool, and moist forested conditions surrounding wetland breeding sites.

R – required management practice

G – guideline or recommended management practice

- R** No motorized vehicle use in wetlands or within 50 feet of wetlands in Four-toed Salamander Priority Habitat. NHESP will indicate the relevant areas on a map included with the review letter sent to the DCR service forester.
- R** Motorized vehicle use on new skid and woods roads, consistent with the Massachusetts Forestry Best Management Practices, may occur between 50 and 250 feet of the high water mark from a breeding pool or other potential wetland breeding habitat only between November 15th and March 15th of any given year and when the ground is frozen or dry. All motorized vehicles shall be excluded from this area between March 16th and November 14th.
- R** Crossing specified breeding wetlands shall only occur if a service forester can verify that wetland microhabitats with sphagnum moss, hummocks and/or sedge and grass tussocks are avoided.
- R** Wetland harvesting shall only occur if a service forester can verify that wetland microhabitats with sphagnum moss, hummocks and/or sedge and grass tussocks are avoided. Wetland harvesting shall only occur in the winter under frozen conditions.
- R** For harvesting within wetlands that is consistent with the Massachusetts Forestry Best Management Practices, the trees that will be harvested shall be marked prior to cutting plan approval and harvesting.
- R** *0 - 50 feet from breeding pool high water mark:* Retain a no-cut filter strip.
- R** *50 – 250 feet from breeding pool high water mark:* Retain $\geq 70\%$ of the area with $\geq 75\%$ canopy cover, or equivalent basal area, of trees ≥ 30 feet in height (see Appendix for residual basal area requirements). Any portion of this area that is cut to $< 75\%$ canopy cover shall retain ≥ 10 square feet of basal area per acre of dominant or co-dominant live trees at least 10 inches dbh.
(Four-toed Salamander life zone)

- R** Within the 250-foot Four-toed Salamander life zone, the areas with <75% canopy cover shall not be concentrated disproportionately close to the wetland breeding site.
- R** If harvesting is to be done within 250 feet of specified wetland breeding habitat within Four-toed Salamander Priority Habitat then a forester licensed to practice forestry in Massachusetts under M.G. L. Ch 132 s 47-50 shall prepare the cutting plan. The cutting plan shall include:
- a narrative explaining the existing forest conditions and the silvicultural prescription
 - a description of how the condition of the residual stand meets Four-toed Salamander habitat requirements such as maintenance of sphagnum moss microhabitat, presence of coarse woody debris, moist soils, and abundant leaf litter
 - a map indicating the areas within 250 feet of the breeding pool that will fall below the 75% canopy cover threshold
- Within the harvesting area, the boundary of the 50 and 250-foot management zones from the wetland shall be clearly identified by flagging or marking prior to cutting plan approval and harvesting. The trees that will be harvested within these management areas shall also be marked prior to cutting plan approval and harvesting.
- R** If the entire area within 250 feet of specified wetland breeding habitat within Four-toed Salamander Priority Habitat is left uncut then a licensed forester is not required to prepare the forest cutting plan and no additional narrative or map is required.
- R** New landings and skid roads must be located at least 100 feet and farther away if possible, from Four-toed Salamander breeding pools, including both Certified and uncertified vernal pools.
- G** Where feasible, extending the Four-toed Salamander life zone beyond 250 feet to 450 feet or even greater would be beneficial for the conservation of Four-toed Salamanders.
- G** Where feasible, retaining more than 70% of the 250-foot Four-toed Salamander life zone with $\geq 75\%$ canopy cover would be beneficial for the conservation of Four-toed Salamanders.
- G** Patch cuts, new landings, and new skid or woods roads, should not be located between wetlands when they are grouped in a cluster. The forested areas between wetlands are important dispersal and migration corridors for Four-toed Salamanders.
- G** Where feasible and in accordance with other regulations, leave two snags/acre or older/dying trees uncut in order to provide a future source of large woody debris that will provide shelter and cover. Small patches of uncut trees around snags would avoid possible safety issues.
- G** Leave sections of downed wood 12 inches and larger in diameter and 15 inches long or larger to provide microhabitat areas of shelter and cover.
- G** Avoid disturbing fallen logs as they are important microhabitat features that provide shelter and cover.
- G** Leave limbs and tops in the forest, consistent with other laws, regulations and forestry best management practices, in order to provide a source of woody debris that can be used as cover and shelter objects.

SPECIES BIOLOGY

Species Identification

The Four-toed Salamander (*Hemidactylium scutatum*) is the smallest salamander in Massachusetts; adults reach a total length of 3.5 inches. It is in the lungless salamander family (Plethodontidae) and absorbs oxygen through its moist skin. Its name refers to the fact that the hind feet have only 4 toes instead of the usual 5 of other salamander species. The back is reddish-brown and the sides are grayish. Another distinguishing feature is a constriction at the base of the tail. This salamander voluntarily sheds its tail as an anti-predator strategy. The tail continues to wiggle in an attempt to distract the predator while the salamander escapes. The tail makes up greater than half the total body length in adults. This salamander can also be identified by its white belly that has either black spots or blotches. It has grooves along its sides that connect with the spine to create a herringbone pattern.



Figure 1. Adult Four-toed Salamander. Note the gray line below the hind legs where the tail will break off in the event of a predator attack.

Four-toed Salamander Biology Quick Reference Chart

Average adult size: 2 - 3.5 inches total length

Hatchling size: $\frac{3}{8}$ - $\frac{5}{8}$ inch total length

Metamorph size: $\frac{3}{4}$ - 1 inch total length

Adult coloration: Reddish brown with gray sides and a white belly with dark spots or blotches

Hatchling/larvae coloration: Mottled yellowish brown

Metamorph coloration: Similar to adults

Time to maturity: 2 years

Life span: 9 or more years

Life Span and Time to Maturity

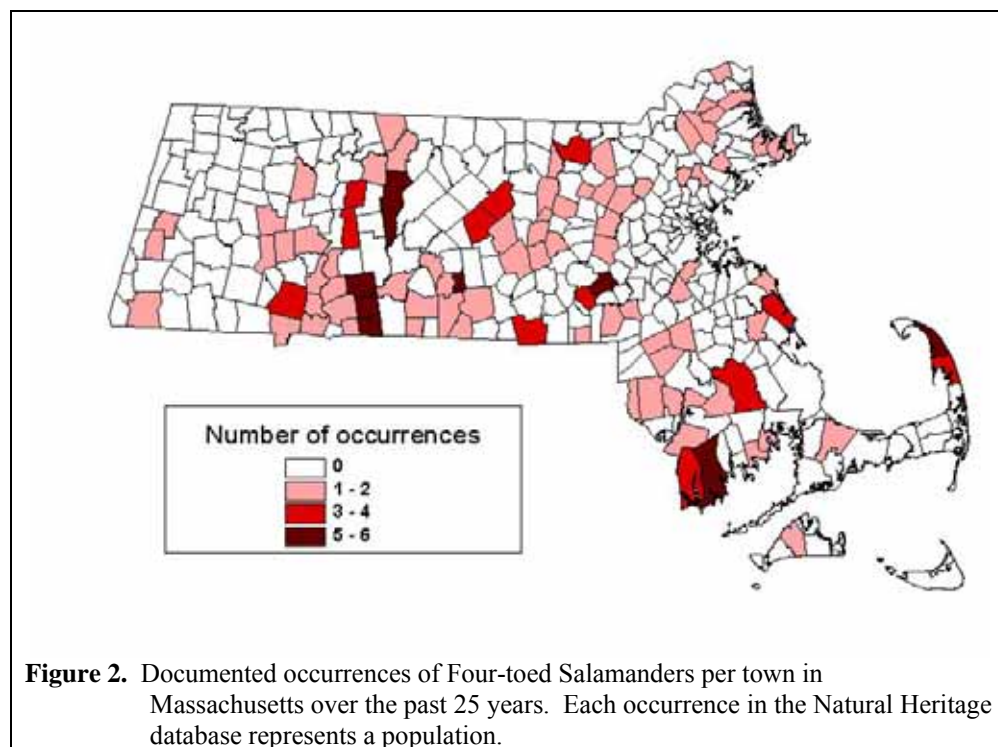
This salamander takes approximately two years after metamorphosis to become sexually mature. They are known to live as long as 9 years.

Similar Species

The Redback Salamander (*Plethodon cinereus*) is in the same family as the Four-toed Salamander and is similar in size and coloration. However, these small woodland salamanders have five toes on the hind feet, lack the white belly with black spots, and lack a tail constriction although they also will lose their tail as an anti-predator defense.

Salamander Range

The Four-toed Salamander has populations as far north as southeastern Canada and as far south as land bordering the Gulf of Mexico. Its range west extends to Oklahoma, Missouri, and Wisconsin. In the southern and western parts of its range, populations are discontinuous. The known occurrences of Four-toed Salamander in Massachusetts are shown in Fig. 2.



Life History of Four-toed Salamanders

Life History Quick Reference Chart		
WHAT	WHERE	WHEN
Overwintering	Terrestrial habitat: forested habitat in well-drained soils with small mammal tunnels and burrows	Late fall to early spring: late November to late March
Female migration to and from nesting sites	Terrestrial and aquatic habitat: overland travel between forested habitat and vernal pools, bogs, swamps, marshes	Spring – late March to May
Metamorphosis and emergence of aquatic larvae	Aquatic to terrestrial habitat: vernal pools, swamps, bogs, marshes, margins of slow moving streams with migration into forested habitat	Late spring to summer: mid-June to July
Courtship and mating	Terrestrial habitat: forested habitat	Late summer to fall
Terrestrial habitat use	Terrestrial habitat: deciduous and mixed deciduous/coniferous forests with fallen logs, deep leaf litter, other decaying large woody debris	Year round
Foraging	Terrestrial and aquatic habitat: larvae forage in wetlands with standing water persisting into the summer and slow moving streams; adults forage in forested habitat	April to November

Four-toed Salamander Movements

The greatest period of movement of adults during the Four-toed Salamanders' activity season is in the spring when females migrate to and from breeding sites. In Massachusetts, these movements begin at the end of March and continue through to the end of June (Wells, 2003). Adults have been found up to 660 feet away from the nearest wetland (Table 1). The juveniles then disperse from the breeding sites once they have metamorphosed in June and July. Another period of increased activity occurs during the late summer and fall when courtship and mating takes place. Some migration of females towards breeding sites may also occur in the late fall in anticipation of the nesting season in the spring.

Location	Maximum straight-line distance	
	moved from wetland (feet)	Source
Quebec	235	Pouliot, pers. comm.
Massachusetts	498	Wells, 2003
Massachusetts	650	Richmond, 1999
Massachusetts	660	Windmiller, 2000

Table 1. Maximum known distances moved by adult Four-toed Salamanders from the nearest wetland.

Reproduction

Four-toed Salamanders use wetlands, including vernal pools, as breeding habitat but their reproduction cycle is slightly different than other vernal pool breeding salamanders. Their mating season occurs in the fall rather than the spring and courtship occurs terrestrially rather than underwater. Females that have mated in the fall will migrate to aquatic breeding sites in the spring. Eggs are laid in terrestrial nests above the water line. Cavities within sphagnum moss or just below it at the edge of swamps, bogs, marshes, vernal pools, and slow moving streams are the preferred nesting areas. However, eggs have also been found under loose bark, in leaf litter, rotted wood and clumps of grass and rushes. Nests are sometimes laid communally and may be guarded by females for a few weeks. Larvae hatch from the eggs after about 5 weeks and then wiggle through the moss into the water below. Metamorphosis from the larval stage to the terrestrial juvenile stage occurs after about 6 weeks.

Terrestrial Habitat Use

Four-toed salamanders live in forested habitats surrounding swamps, bogs, marshes, vernal pools, and other fish-free aquatic sites that are used as breeding sites. Adults are infrequently encountered outside of the spring nesting period. They are associated with mature hardwood or coniferous forests and when encountered can be found under cover objects such as logs, bark and boards on the forest floor. Juvenile and adult male salamanders are primarily terrestrial. Four-toed Salamanders are associated with aquatic habitat for a few weeks to months in the early spring and summer. Four-toed Salamanders overwinter in forested habitat in holes, channels and other crevices in ground.

Foraging

Larval Four-toed Salamanders feed on small zooplankton and other small invertebrates. Adults eat invertebrates such as beetles, spiders, mites, bristletails, and moths.

FOUR-TOED SALAMANDER CONSERVATION CONCERNS

Status Across Range

In Massachusetts, the Four-toed Salamander is listed as a species of special concern. The status of the Four-toed Salamander in other parts of its range is shown in Fig. 3.

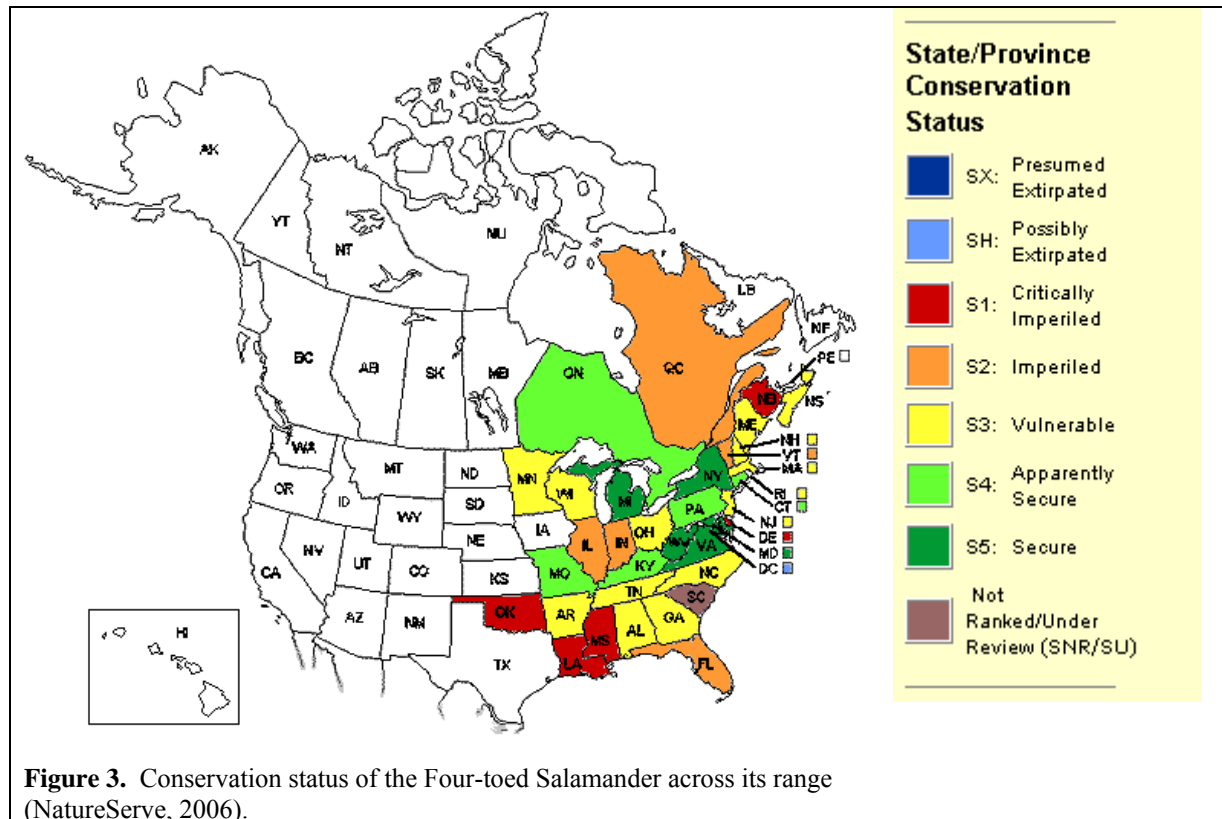


Figure 3. Conservation status of the Four-toed Salamander across its range (NatureServe, 2006).

Activities that Impact Four-toed Salamander Populations

Habitat Loss, Degradation, and Fragmentation

Four-toed salamander populations are at risk from the loss, degradation, and fragmentation of both the aquatic breeding pool habitat required for reproduction and the terrestrial habitat needed for foraging, overwintering, growth and development. Although protection is increasing for Four-toed salamanders' aquatic habitat, a sufficient percentage of the surrounding terrestrial habitat is not usually included in this protection.

Permanent loss of the terrestrial habitat can occur because of commercial and/or residential development. Loss of the breeding habitat can occur because of draining or filling. Wetland breeding habitats can also be lost as successful reproductive sites if the hydrology of the habitat is altered. If changes to the local land use result in less water reaching the wetland, then it may not retain water long enough for the Four-toed salamanders to develop to metamorphosis. For example, construction blasting near vernal pools in order to build foundations has resulted in the significant reduction of hydroperiod

and, therefore, in the loss of vernal pool habitat. Alternatively, if the amount of impermeable surfaces, such as paved roads and parking lots, increases nearby such that there is increased run-off into the wetland, this can also have negative effects. Increased runoff can also decrease the water quality if erosion and subsequent sedimentation occurs or if contaminants reach the pool.

Temporary loss of suitable salamander habitat can occur after clear-cutting forested habitat (Petranka et al. 1993). Habitat degradation and the ultimate loss of hospitable terrestrial habitat for Four-toed salamanders can occur if heavy equipment causes rutting and extensive soil compaction, leading to the loss of underground tunnels and burrows. Removal of coarse woody debris and other cover objects can lead to the loss of suitable microhabitats within the forest, and disturbance to the leaf litter on the forest floor can be detrimental. Sphagnum moss nesting sites are also an essential microhabitat within forested wetlands.

Fragmentation of habitats and protection of single populations without consideration of connections between populations at a landscape scale threaten the long-term viability of species populations and interferes with biological processes. Fragmentation because of roads, curbs, impermeable fencing or other impassable surfaces can hinder migration to breeding pools within local populations. At a landscape scale, it can isolate populations genetically and prevent immigration from populations acting as a source of new individuals to populations that are decreasing in abundance.

Water Pollution

The initial growth and development of Four-toed Salamanders occur in pools of water. Four-toed Salamander larvae inhabit aquatic sites for up to two months prior to their metamorphosis to a terrestrial juvenile. The quality of the larval habitat is important, not only to reach metamorphosis successfully, but it can also have implications for the health of the adult population. Evidence suggests that amphibians that are a larger size at metamorphosis due to ideal growing conditions develop into larger adults and have an associated increase in their reproductive potential. Larger female amphibians produce more eggs than smaller individuals and larger males may have greater success when competing with smaller males for breeding females.

Even when habitat is protected for wetland breeding amphibians, impacts from the surrounding land use can have negative effects (Brooks et al. 2002). Run-off from pesticides used on lawns, oil leaking onto roads from cars, and agricultural contaminants in the form of chemicals and animal wastes will all affect the water quality of breeding habitat. Decreased water quality has been correlated with reduced embryo hatching success and reduced larval survival. Not all sources of pollution occur locally since distant sulphur and nitrogen pollution contributes to acid precipitation which also affects water quality negatively. Acidic conditions can be lethal to amphibian embryos directly, or can reduce hatching success, slow larval development, and have been associated with embryo abnormalities.

Roadkill

For Four-toed Salamander populations whose habitat has already been fragmented by roads separating the breeding habitat from the terrestrial habitat, adult mortality due to vehicles can occur during breeding migrations. Public awareness of the importance of vernal pool habitats is fairly high in Massachusetts and volunteers often participate in spring “big nights” when the majority of the adult amphibians are moving to their local breeding site. Volunteers place amphibian crossing signs, aid in slowing traffic flow, and move individual amphibians off the road. Culverts specifically installed to aid salamander movement underneath a road have been installed in some locations. However, for other populations that are not assisted by volunteers or culverts, repeated vehicular mortality year after year can ultimately lead to the loss of a local population.

Forestry

Maintaining forested habitat in association with wetland breeding sites is essential for the conservation of Four-toed Salamanders. The primary concerns about forestry practices within rare Four-toed salamander habitat are damage to sphagnum hummock and pool breeding habitat because of motorized vehicle crossing and alteration of forested habitat surrounding breeding sites. A fairly substantial body of literature has been published on the effects of forestry on terrestrial salamanders within the same family as Four-toed Salamanders (deMaynadier and Hunter, 1995). Due to similarity in size and physiological constraints because of being lungless and respiring through their moist skin, the results of these studies is particularly relevant to Four-toed Salamander habitat affected by forestry in Massachusetts. Many studies have investigated the abundance of salamanders in the lungless salamander family (Plethodontidae) in different forest age classes and found that the abundance is significantly reduced in two-age and clearcut stands harvested from less than 5 to 15 years previously as compared to mature forests (Duguay and Wood, 2001; Petranka et al., 1994). For example, a study in the southern Appalachians found that the abundance of Plethodontid salamanders was less in areas that were clearcut within the previous 10 years as compared to mature forest stands greater than 50 years old (Petranka et al., 1993 and 1994). Similarly, density of Plethodontid salamanders was significantly greater in old-growth forests greater than 120 years old as compared to second-growth sites 70-80 years old and regeneration-cut sites less than 5 years old (Herbeck and Larsen, 1999). The effects of multiple timber harvest methods have also been compared and the reduction in Plethodontid salamander abundance was similar in canopy removal treatments resulting from seedtree, group selection, shelterwood cuts and clearcuts (Harpole and Hass, 1999; Knapp et al., 2003; Morneau et al., 2004). There is some evidence to suggest that salamander abundance begins increasing post-shelterwood harvests within 3-5 years in conifer stands (Brooks 2001; Morneau et al., 2004) and that with maintenance of cover objects and residual canopy cover, salamander abundance levels can potentially recover in one to two decades after thinning harvests (Brooks, 1999).

Some of the specific features within a forest that have been identified as important for salamanders are a predominantly closed-canopy, a deep layer of deciduous leaf litter, availability of large and decaying coarse woody debris, the presence of small mammal tunnels, and moist and cool forest floor conditions. Alteration of these features could result in salamander mortality, reduced or failed reproduction, and subsequent population decline and loss. Direct mortality of salamanders due to crushing by mechanized equipment is a concern. Similarly, the loss of underground burrows or tunnels to soil compaction by machinery can lead to decreased survival rates of adult and juvenile salamanders.

FORESTRY CONSERVATION MANAGEMENT PRACTICES FOR FOUR-TOED SALAMANDERS

The following management practices apply to forested areas surrounding wetlands that function as breeding habitat in Four-toed Salamander Priority Habitats. NHESP recognizes that impacts to Four-toed Salamander habitat from forestry are temporary. Different standards for Four-toed Salamander conservation will be applied to other projects and activities that impact Four-toed Salamander Priority Habitat.

Preventing Salamander Mortality

Conservation management objective

Reduce direct mortality of Four-toed Salamanders from any forestry-associated activity involving motorized equipment, reduce soil compaction and destruction of underground burrows and tunnels, minimize rutting and disturbance to leaf litter and sphagnum moss nesting sites.

Rationale

Adult Four-toed Salamanders have two peak periods during their active season when they are the most concentrated above ground. These occur during the fall mating period and the spring migration period. During the summer, newly metamorphosed juveniles migrate away from breeding sites. By accessing forested areas during the winter, when the ground is frozen and when Four-toed Salamanders are inactive, direct mortality and damage to important microhabitats will be reduced.

General management recommendations

Adjust the timing of mechanized forestry activities so that the Four-toed Salamander is inactive and the ground is frozen.

Specific management practices

- R** No motorized vehicle use in wetlands or within 50 feet of wetlands in Four-toed Salamander Priority Habitat. NHESP will indicate the relevant areas on a map included with the review letter sent to the DCR service forester.
- R** Motorized vehicle use on new skid and woods roads, consistent with the Massachusetts Forestry Best Management Practices, may occur between 50 and 250 feet of the high water mark from a breeding pool or other potential wetland breeding habitat only between November 15th and March 15th of any given year and when the ground is frozen or dry. All motorized vehicles shall be excluded from this area between March 16th and November 14th.

Maintenance of breeding site habitat integrity and forest floor conditions

Conservation management objectives

Protect the hydrology, water quality, and physical integrity of breeding pools. Maintain shaded, moist, and cool conditions in the forested habitat surrounding wetland breeding sites that are used by Four-toed Salamanders.

Rationale

Wetlands, such as swamps, bogs, marshes and vernal pools, and the surrounding forest provide essential habitat for Four-toed Salamanders to complete their life cycle. Providing shaded, moist, and cool conditions, including deep forest floor litter and coarse woody debris, are necessary for maintaining upland and breeding pool habitats.

General management recommendations

Maintain land surrounding aquatic breeding sites used by Four-toed Salamanders in a predominantly forested condition.

Specific management practices

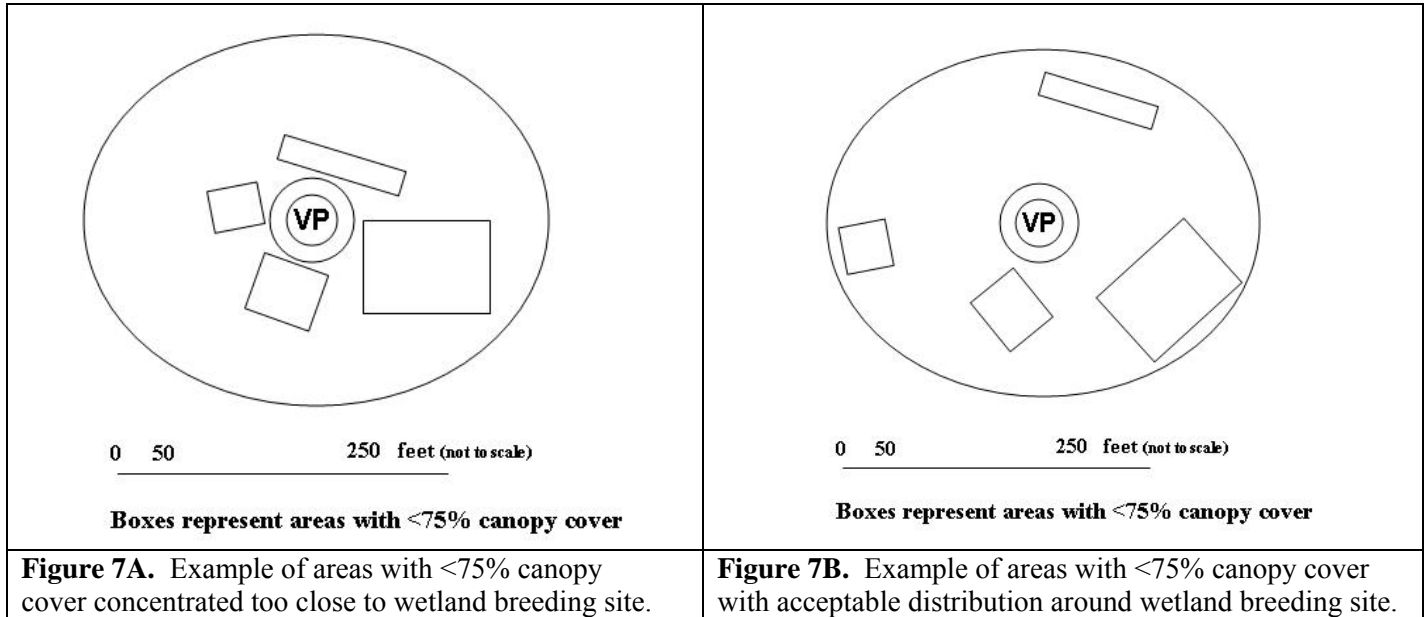
The following stand treatments must be followed within 250 feet of specified wetlands within Four-toed Salamander Priority Habitat. NHESP will indicate the relevant areas on a map included with the review letter sent to the DCR service forester.

- R** Crossing specified breeding wetlands shall only occur if a service forester can verify that wetland microhabitats with sphagnum moss, hummocks and/or sedge and grass tussocks are avoided.
- R** Wetland harvesting shall only occur if a service forester can verify that wetland microhabitats with sphagnum moss, hummocks and/or sedge and grass tussocks are avoided. Wetland harvesting shall only occur in the winter under frozen conditions.
- R** For harvesting within wetlands that is consistent with the Massachusetts Forestry Best Management Practices, the trees that will be harvested shall be marked prior to cutting plan approval and harvesting.
- R** *0 - 50 feet from breeding pool high water mark:* Retain a no-cut filter strip
- R** *50 – 250 feet from breeding pool high water mark:* Retain $\geq 70\%$ of the area with $\geq 75\%$ canopy cover, or equivalent basal area, of trees ≥ 30 feet in height (see Appendix for residual basal area requirements). Any portion of this area that is cut to $< 75\%$ canopy cover shall retain ≥ 10 square feet of basal area per (Four-toed Salamander life zone)

acre of dominant or co-dominant live trees at least 10 inches dbh.*

- * These percentages apply only when the area surrounding the aquatic breeding site is entirely forested. A higher percentage of the area may need to be maintained at 75% canopy cover if within the area within 250 feet of the breeding pool is not entirely forested.

R Within the 250-foot Four-toed Salamander life zone, the areas with <75% canopy cover shall not be concentrated disproportionately close to the wetland breeding site.

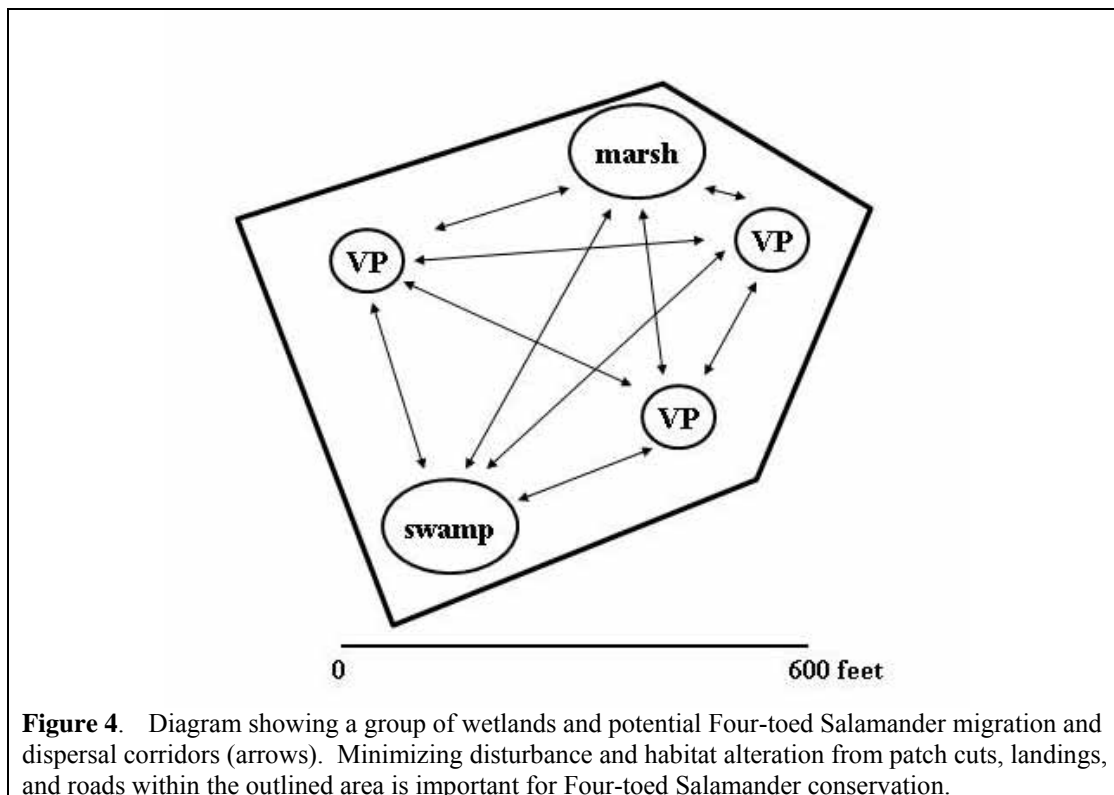


R If harvesting is to be done within 250 feet of specified wetland breeding habitat within Four-toed Salamander Priority Habitat then a forester licensed to practice forestry in Massachusetts under M.G. L. Ch 132 s 47-50 shall prepare the cutting plan. The cutting plan shall include:

- a narrative explaining the existing forest conditions and the silvicultural prescription
- a description of how the condition of the residual stand meets Four-toed Salamander habitat requirements such as maintenance of sphagnum moss microhabitat, presence of coarse woody debris, moist soils, and abundant leaf litter
- a map indicating the areas within 250 feet of the breeding pool that will fall below the 75% canopy cover threshold

Within the harvesting area, the boundary of the 50 and 250-foot management zones from the wetland shall be clearly identified by flagging or marking prior to cutting plan approval and harvesting. The trees that will be harvested within these management areas shall also be marked prior to cutting plan approval and harvesting.

- R** If the entire area within 250 feet of specified wetland breeding habitat within Four-toed Salamander Priority Habitat is left uncut then a licensed forester is not required to prepare the forest cutting plan and no additional narrative or map is required.
- R** New landings and skid roads must be located at least 100 feet and farther away if possible, from Four-toed Salamander breeding pools, including both Certified and uncertified vernal pools.
- G** Where feasible, extending the Four-toed Salamander life zone beyond 250 feet to 450 feet or even greater would be beneficial for the conservation of Four-toed Salamanders.
- G** Where feasible, retaining more than 70% of the 250-foot Four-toed Salamander life zone with $\geq 75\%$ canopy cover would be beneficial for the conservation of Four-toed Salamanders.
- G** Patch cuts, new landings, and new skid or woods roads, should not be located between wetlands when they are grouped in a cluster (Fig. 4). The forested areas between wetlands are important dispersal and migration corridors for Four-toed Salamanders.



- G** Where feasible and in accordance with other regulations, leave two snags/acre or older/dying trees uncut in order to provide a future source of large woody debris that will provide shelter and cover. Small patches of uncut trees around snags would avoid possible safety issues.
- G** Leave sections of downed wood 12 inches and larger in diameter and 15 inches long or larger to provide microhabitat areas of shelter and cover.

- G** Avoid disturbing fallen logs as they are important microhabitat features that provide shelter and cover.
- G** Leave limbs and tops in the forest, consistent with other laws, regulations and forestry best management practices, in order to provide a source of woody debris that can be used as cover and shelter objects.

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APPENDIX

Draft residual basal area levels of trees >4 inch dbh sampled with a BAF-10 prism for 75% canopy cover within the Four-toed Salamander life zone. Residuals trees should be greater than or equal to 30 feet in height.*							
Average Stand dbh (inches)	Forest Type**						
	WP, WK, RP, SR, PP, HK, TK, CD, SF	WH, HH	BW, RM, BC, BB, SM, BM, BE	W0, PO	OH	OR, OM	
4	50	40	25	20	15	10	
5	60	50	35	30	25	20	
6	70	55	35	30	25	20	
7	80	65	40	35	30	25	
8	85	70	45	40	35	30	
9	90	70	45	40	35	30	
10	95	75	50	45	40	35	
11	95	75	50	45	40	35	
12	100	80	55	50	45	40	
13	105	85	55	50	45	40	
14	110	90	60	55	50	45	
15	110	90	60	55	50	45	
16	115	95	65	60	55	50	
17	120	95	65	60	55	50	
18	120	100	70	65	60	55	
19	120	100	70	65	60	55	
20	125	105	75	70	65	60	
21	125	105	75	70	65	60	
22	125	110	80	75	70	65	
23	125	110	80	75	70	65	
24	130	115	80	75	70	65	
25	130	115	85	80	75	70	
26	130	120	90	85	80	75	

*Residual basal area required for 70% of the life zone (remaining 30% of life zone has 10 square feet/acre residual basal area requirement).
 **Refer to Ch. 132 Forest Cutting Plan form for definition of forest types.